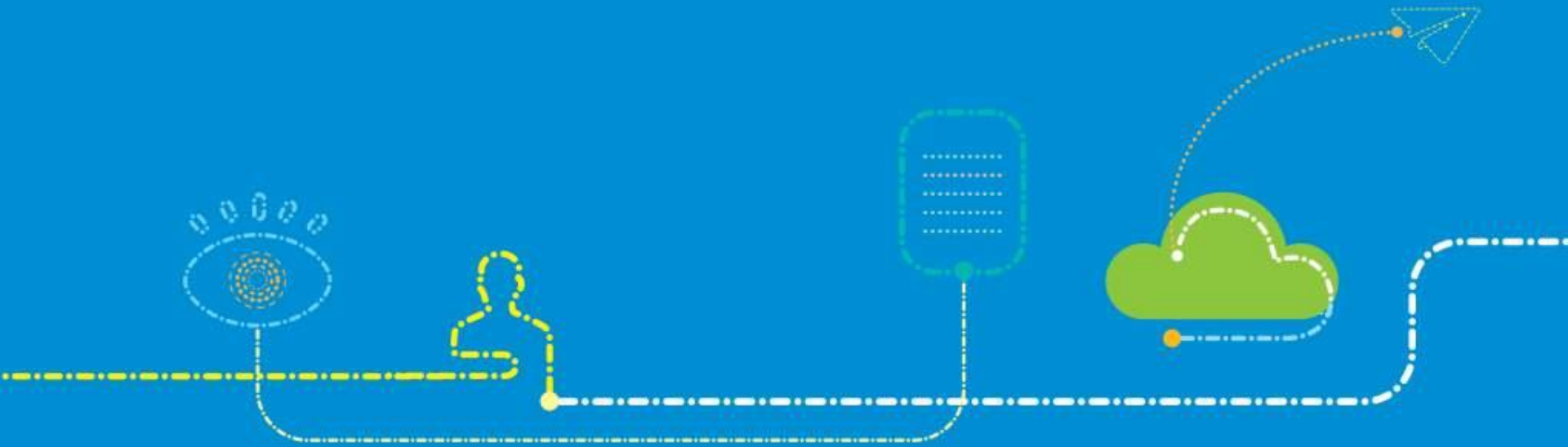
3GPP TSG RAN Rel-19 workshop
Taipei, June 15 - 16, 2023

RWS-230299

Source: ZTE, Sanechips

Agenda: 5

Views on Ambient IoT in Rel-19



Overviews

- **Motivation**
  - The automation and digitalization of various industries open numbers of new markets requiring Ambient-IoT technologies which support battery-less devices with no energy storage capability or devices with energy storage that do not need to be replaced or recharged manually.

- **Current status**
  - The use cases, potentially new service requirements / KPIs have been identified and captured in TR 22.840 in SA1.
  - RAN stuty item on Ambient-IoT was approved in RP-223396. It's common understanding in RAN that Ambient IoT is a part of mobile communication eco-system (i.e. not as an "independent" technology).
  - The RAN study focuses on high level aspects, such as use case categorization, deployment scenarios and connectivity topologies and design targets, e.g., device complexity, coverage etc. Detailed technologies on how to achieve these RAN targets are not expected to be discussed during Rel-18.

- **Justification for Rel-19 SI on Ambient-IoT**
  - As the initial version of Ambient-IoT, a comprehensive study is needed to avoid non-backward compatible issue in subsequent evolutions and deployments.

Proposal 1: SI only in Rel-19 to ensure sufficient study for Ambient IoT. The corresponding WI can be started in Rel-20.

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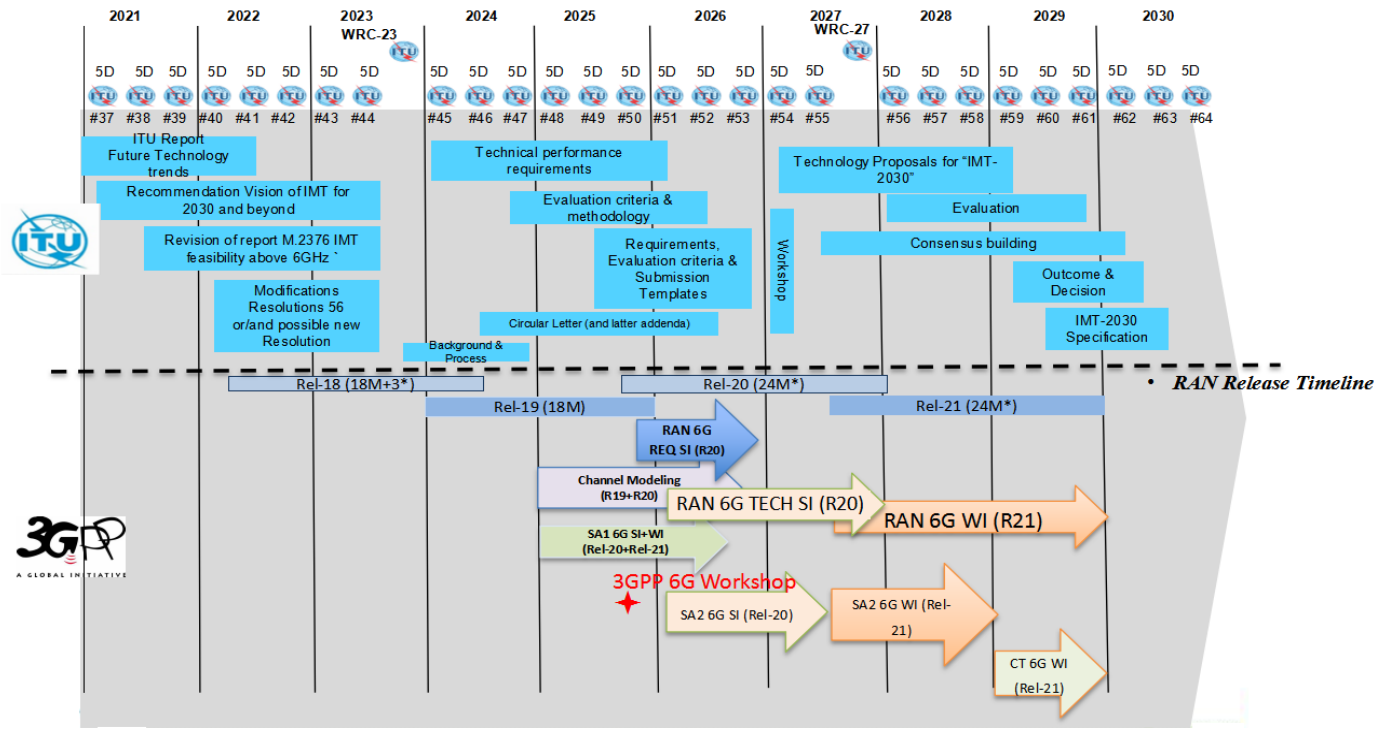
Ambient IoT and 6G



Proposal 2: Ambient IoT can be standardized in Rel-20 NR but it can be also a part of 6G package. i.e. no additional 6G Ambient IoT to be developed in 6G time-frame.

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Deployment scenarios

- **Use case**
  - All 4 use cases, i.e. inventory, sensors, positioning and command, need to be consierded based on their performance requirements in Rel-19 SI.
- **Device type**

Device Type A	•Backscattering transmission w/o energy storage, 1~10 uw
Device Type B	•Backscattering transmission with energy storage
Device Type C	•Independent signal generation, 1~10mw

  - The device's peak power consumption shall be limited by its energy source and practical form factor for the intended use cases.
  - Each Ambient IoT device type has the corresponding complexity and performace requirements depending on its peak power consumption.

Proposal 3: All 3 device types and all 4 use cases can be further studied in Rel-19 SI.

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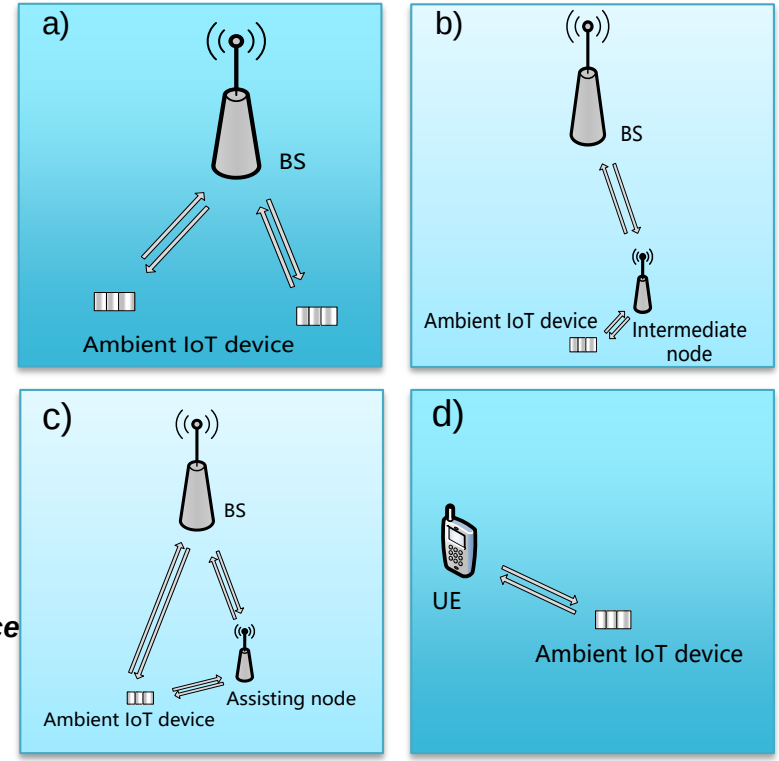
Deployment scenarios

- **Spectrum**
  - Focus on licensed FDD and TDD bands in Rel-19 SI. The unlicensed bands can be deprioritized.
- **Connectivity topology**
  - Topology a: The direct connection between BS and Ambient IoT device is the baseline requirement.
  - Topology b, c: The network connections utilizing additional node are enhanced topologies.
  - Topology d: The direct connection between UE and Ambient IoT device is an extended requirement.
  - Hence, the priority of connectivity topology is a>b=c>d.

Proposal 4: Direct connection between BS and Ambient IoT device should be the baseline in R19 SI

- ***The priority of connectivity topology in Rel-19 SI is a>b=c>d.***



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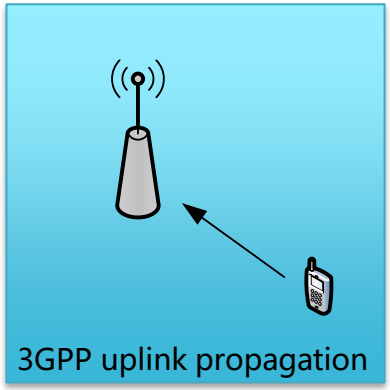
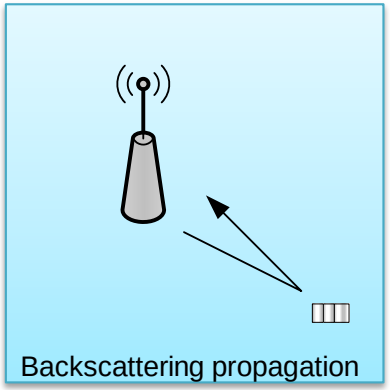
Backscattering signal modeling

- The existing 3GPP signal is an unidirectional signal with independent uplink or downlink propagation characteristic.
- Meanwhile, the uplink backscattering signal in Ambient IoT communication generally can be regarded as a reflected signal of the downlink signal, which includes some downlink propagation characteristics.
- Therefore, backscattering signal modeling needs to be studied in Rel-19 SI.





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Physical layer techniques

- **Study on physical layer techniques**
  - Including coding and modulation schemes, radio frame structure, physical channels and signals, initial access process, positioning scheme, etc.
- **Evaluation on physical layer techniques**
  - Performance evaluation
    - SA1 and RAN have discussed the KPI requirements and design targets on device complexity, coverage, latency, connection density, user-experienced data rate, communication cervice availability, maximum message size, device speed, positioning accuracy, etc.
    - The performance evaluation including evaluation methodologies, evaluation assumptions.
    - The identified physical layer techniques should be studied and evaluated. Enhancements can be considered if performance gap between the requirements and studied technologies is observed.
  - Coexistence issue
    - The coexistence with existing 3GPP technologies needs to be considered to support different operation modes, for example, in-band mode, guard-band mode and standalone mode.

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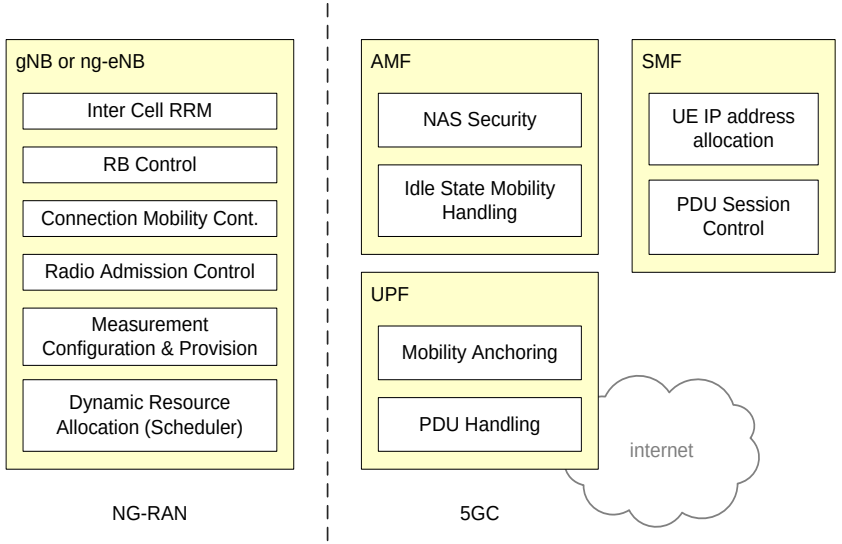
High layer techniques

- **Light Protocol stack**
  - Study the simplified protocol stack and protocol functionality
- **Resource management**
  - Study the radio resource allocation by network for Ambient IoT communication
- **Mobility management**
  - Study the awareness of device location and device reachability
- **Transmission management**
  - Study the signaling connection management between UE and the network
  - Study the data transmission via control plane
- **Security**
  - Study the simplified identification and authentication for UE by the network.
  - Study the simplified encryption communication between UE and the network.



Function split between NG-RAN and 5GC in TS 38.300

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Scope for Rel-19 Ambient IoT SI

- **Summary**
  - Ambient IoT is a part of mobile communication eco-system (i.e. not as an “independent” technology).
  - Ambient IoT is a part of 6G package. No additional 6G Ambient IoT will be developed in 6G timeline.
  - Use cases include inventory, sensors, positioning and command should be considered in Rel-19 SI.
  - Device types include Device A, Device B, Device C should be considered in Rel-19 SI.
  - The direct connection between BS and Ambient IoT device should be the baseline in R19 Ambient IoT SI.

- **Scope**
  - Study and evaluation on physical layer techniques, including:
    - Receiver structure, waveform, bandwidth, SCS, coding and modulation schemes, radio frame structure, physical channels and signals, initial access procedure, positioning, etc.
    - Evaluation on performance (evaluation methodology, evaluation assumptions) and coexistence impact.
    - Backscattering signal modeling.
  - Study on high layer technique, including:
    - Study the basic communication functions of in higher layer, including simplified protocol stack, resource management, mobility management, connection management, data transmission, security, etc.

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Thanks

Tomorrow never waits